ANALIZA KONTROLE I TAČNOSTI PROIZVODNOG PROCESA PRAĆENJEM IZMERENE KARAKTERISTIKE KVALITETA

ANALYSIS OF CONTROL AND ACCURACY OF THE PRODUCTION PROCESS BY MONITORING THE MEASURED QUALITY CHARACTERISTIC

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Stručni rad

REZIME

Ovaj naučno-istraživački rad posvećen je analizi kvaliteta proizvodnog procesa kroz praćenje određene merene karakteristike, označene sa x. Na osnovu prikupljenih podataka, razvijene su odgovarajuće kontrolne karte koje omogućavaju praćenje varijacije i srednje vrednosti procesa. U procesu su utvrđene granice kontrole koje pomažu u prepoznavanju odstupanja od standarda kvaliteta. Takođe, provedena je provera tačnosti proizvodnog procesa, kako bi se odredilo da li se proces nalazi u kontrolisanom stanju. Tema rada je od velikog značaja za unapređenje sistema osiguranja kvaliteta u industrijskim i proizvodnim procesima, jer omogućava pravovremeno prepoznavanje problema i optimizaciju proizvodnje u cilju postizanja stabilnih i visoko kvalitetnih rezultata.

Professional paper

SUMMARY

This scientific research paper is dedicated to the analysis of the quality of the production process through monitoring a specific measured characteristic, labeled as x. Based on the collected data, appropriate control charts were developed to track the variation and mean values of the process. Control limits were established in the process to help identify deviations from quality standards. Additionally, an accuracy check of the production process was conducted to determine whether the process is in a controlled state. The topic of this paper is of great importance for improving quality assurance systems in industrial and manufacturing processes, as it enables timely identification of issues and optimization of production to achieve stable and high-quality results.

1. INTRODUCTION

Manufacturing processes, in every industrial sector, play a key role in ensuring high-quality and competitive products. One of the main challenges in production is maintaining consistent product quality, which must be monitored and controlled throughout the entire production process. Product quality depends on many factors, including the manufacturing technique, applied technology, materials used, and the ability to monitor and control all relevant product characteristics.

The control and accuracy of the manufacturing process often depend on the precision and efficiency of the quality characteristics measurement system. Measured quality characteristics, such as dimensional accuracy, mechanical properties, surface finish, and other important product features, play a crucial role in determining whether the product meets the standards and market requirements.

Quality control in manufacturing processes is essential for maintaining standardized products. This research paper analyzes the manufacturing process by measuring the quality characteristic x, monitoring whether the process remains within the defined tolerances ($T = 55 \pm 0.06$)

For the purpose of the analysis, data obtained from measurements of n=12 samples over 21 time intervals are used. The goal is to create control charts and examine the accuracy of the process.

2. METHODOLOGY

2.1. Formation of control charts

Control charts are a tool for monitoring variations in a process over time. In this study, the following are used:

• The mean chart ($\bar{x}$): for analyzing the central tendency of the samples.

• The range chart (R): for monitoring the difference between the maximum and minimum values in each sample.

Control limits are determined based on the statistical parameters of the sample:

• Upper control limit (GKG) za $\bar{x}$:

$$(GKG) = \bar{x} + A_2 \cdot R. \qquad (1)$$

• Lower control limit (DKG) za $\bar{x}$:

$$(DKG) = \bar{x} - A_2 \cdot R, \qquad (2)$$

where are:
$\bar{x}$ - the mean of the samples,
R - the average range, and
A_2 - factor that depends on the sample size (n=12).

3. PROCESS ACCURACY TESTING

Process accuracy testing represents a key component in quality control analysis in a manufacturing environment. In the context of

this research, process accuracy refers to the ability of the manufacturing system to consistently produce products that meet the specified technical specifications and quality requirements, with minimal deviations from optimal parameters.

The accuracy of the manufacturing process is typically measured through the analysis of measured quality characteristics, which may include dimensional, mechanical, or other relevant properties of the product. These characteristics are compared with specifications to determine variation in production and identify potential issues in the process.

For process accuracy testing, statistical tools, such as control charts (e.g., Shewhart control charts), were used to enable continuous monitoring of deviations in real-time. By analyzing these data, it is possible to identify sources of errors and discrepancies, as well as predict necessary corrections to improve the precision and stability of the process.

In this research, process accuracy was also assessed using metrics such as the mean (X-bar), standard deviation, and range (R), all aimed at evaluating the stability of the process and its performance. Through the analysis of data obtained from the production line, the relationship between output quality characteristics and potential variations in input parameters was explored, revealing potential areas for optimizing the manufacturing process.

4. RESULTS

This research paper analyzes the control and accuracy of the production process by monitoring the measured quality characteristics. The results of the study are based on the analysis of data collected during the production process, using appropriate quality measurement methods and techniques, as well as statistical methods for assessing the accuracy and efficiency of quality control.

4.1. Data processing

For 21 samples, the mean values ($\bar{x}$) and ranges (R) were calculated:
• The average value for control charts:

$$\bar{\bar{x}} = \frac{\bar{x}_i}{k}, \quad k = 21$$

(3)

- Average range:

$$\bar{R} = \frac{R_i}{k}$$

(4)

4.2. Control limits

Based on n=12, the factor A_2=0.18 was taken

from standard tables. The control limits were calculated for the $\bar{x}$-chart and R-chart.

4.3. Graphical representation

Based on the obtained control limits, control charts were created. These allow for visualizing whether the process maintains stability.
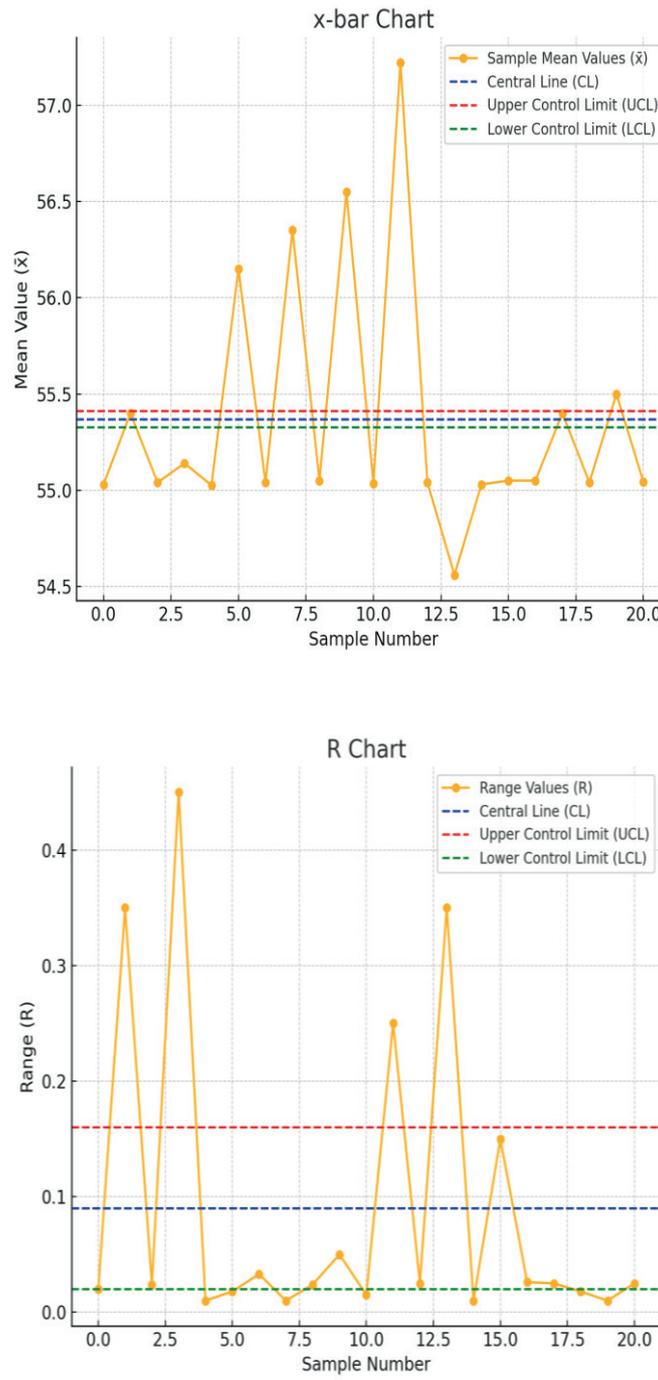

Figure 1. *Graphical representation of mean value $\bar{x}$ and range R*

The graphical representation includes two control charts:

1. **x-bar chart**: Displays the mean values ($\bar{x}$) of each sample with a central line (CL), upper control limit (UCL), and lower control limit (LCL).
2. **R chart**: Displays the ranges (R) for each sample with the same control limits.

5. DISCUSSION

Based on the control charts and measurement results, the process was analyzed for stability.

The focus was directed on:
- Samples that exceed the control limits.
- Samples showing a trend of increasing or decreasing values.
- Samples indicating the presence of systematic errors.

Observed anomalies
- Samples 2, 12, and 14 show significant deviations and require further analysis.

Variations in other samples are within the allowed limits.

6. CONCLUSION

The analysis of control and accuracy in the manufacturing process through monitoring measured quality characteristics is a key element in achieving optimal production efficiency and maintaining quality standards. By tracking relevant metrics, deviations from set goals are identified, enabling timely responses and corrective actions.

The introduction of a quality monitoring system not only improves the accuracy of the manufacturing process but also contributes to increased customer satisfaction through consistent delivery of high-quality products. Technical processes, such as Statistical Process Control (SPC) and the application of modern measurement and analysis tools, allow for the identification of the causes of variations, ensuring process stability and predictability.

Based on the analysis results, it can be concluded that the implementation of these methods helps reduce production costs by eliminating errors and waste, while simultaneously increasing productivity. Maintaining precision and continuous improvement through feedback from measurements contributes to the long-term success of the production system.

Ultimately, it has become clear that integrating technical, organizational, and human factors is crucial for achieving optimal quality control. Further improvement of monitoring and analysis processes, relying on modern technologies, can provide a competitive advantage and sustainable development in a rapidly changing industrial environment.

7. REFERENCES

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